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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Rajeev Shorey, et al.

Docket No. JP920000271US1

Serial No. 09/718,679

Group Art Unit: 2152

Filed: November 22, 2000

Examiner:

Batch No.:

Confirmation No.: 5343

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Technology Center 2100

For: METHODOLOGY FOR IMPROVING TCP THROUGHPUT OVER LOSSY COMMUNICATION LINKS

Commissioner for Patents
Washington, D.C. 20231

SUBMISSION OF FORMAL DRAWINGS

Sir:

Submitted herewith are Eleven (11) Formal Drawing sheets for filing in the above-indentified application.

Respectfully submitted,

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Date: January 17, 2002

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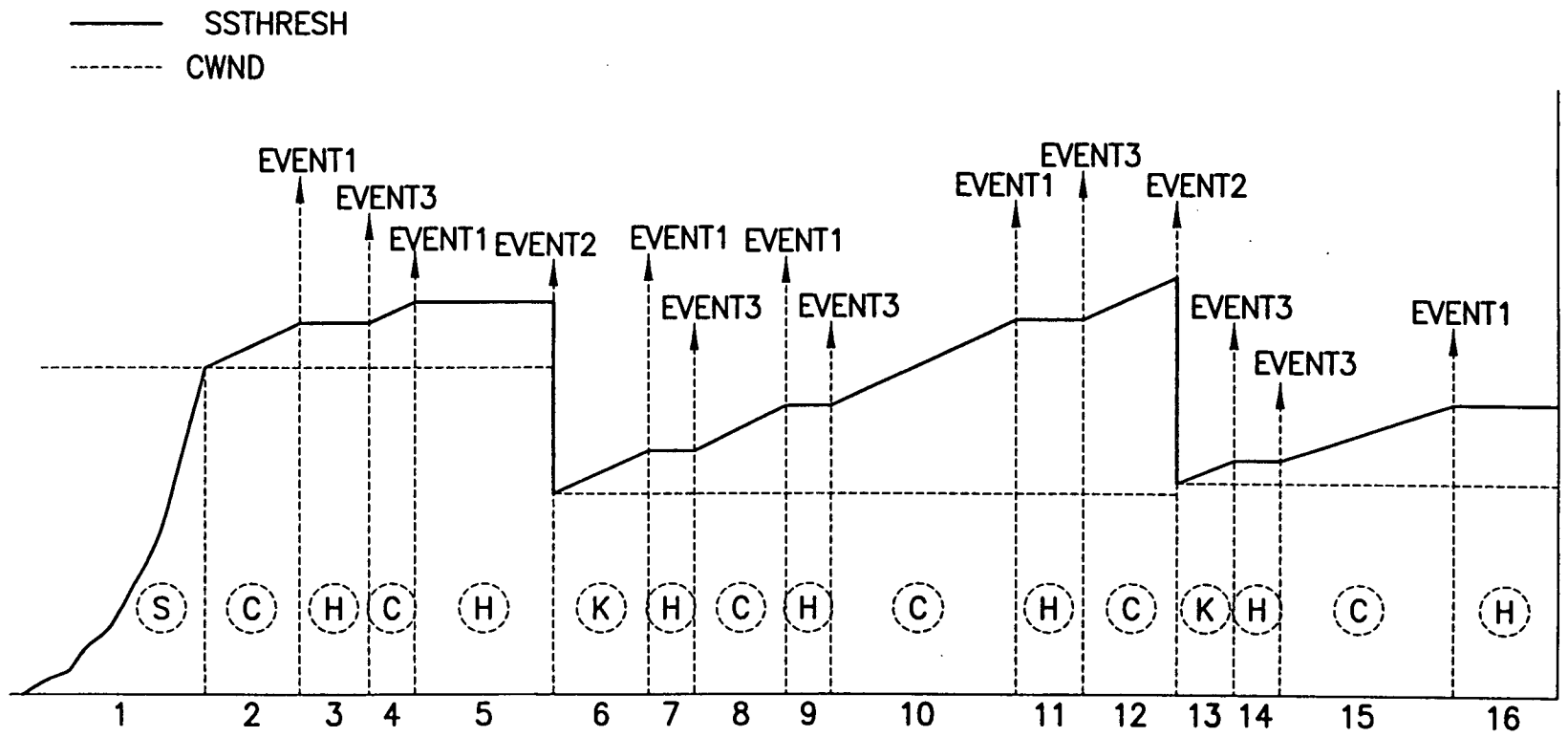


(S) – SLOW START PHASE

(C) – CONGESTION AVOIDANCE PHASE

(H) – HALT GROWTH PHASE

(K) – KRECOVERY PHASE

EVENT1 – DETECTED SINGLE LOSS
EVENT2 – DETECTED 2 LOSSES
EVENT3 – RECOVERED SINGLE LOSS

FIG.1

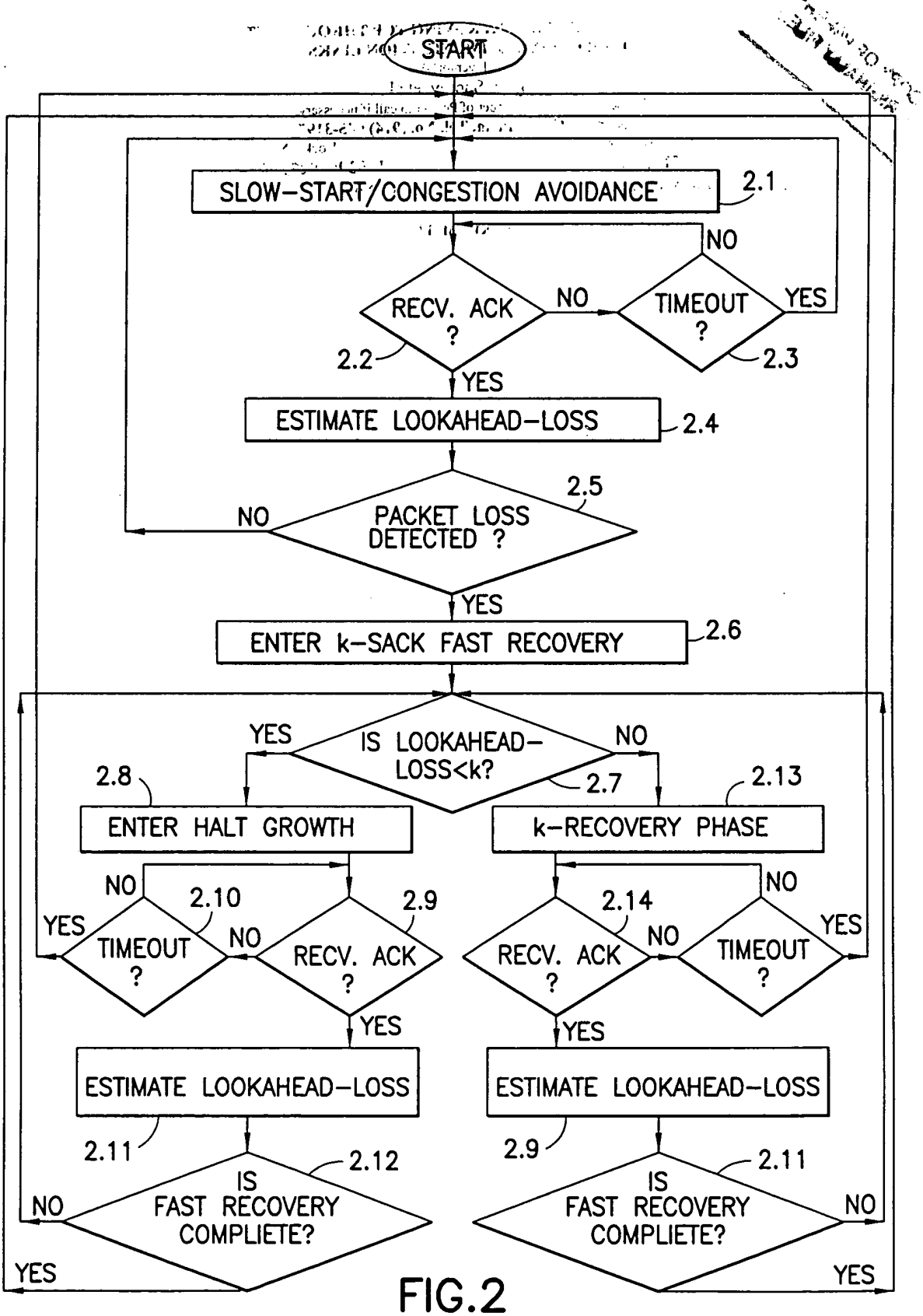
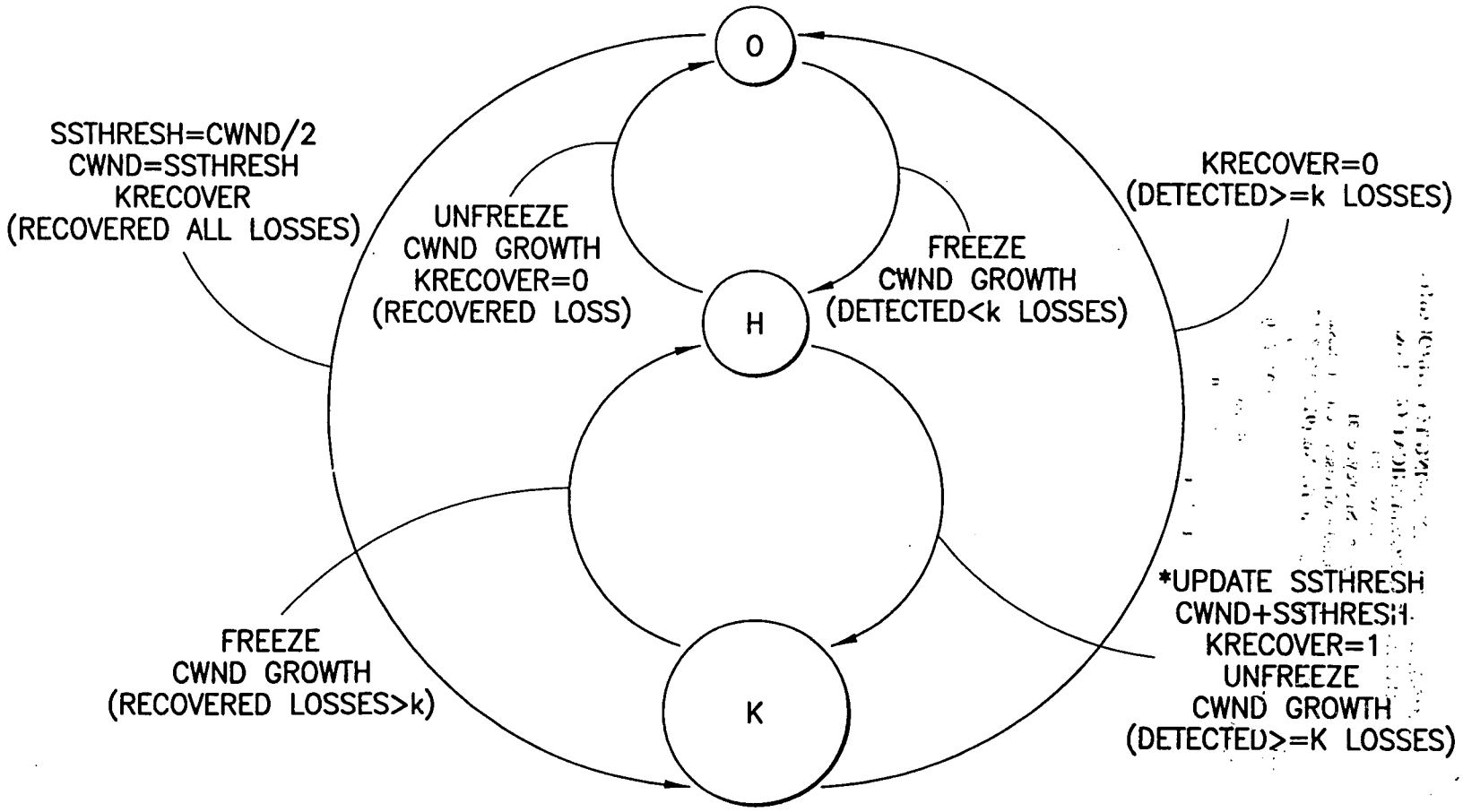

START
SLOW-START/CONGESTION AVOIDANCE
2.1
NO
RECV. ACK ?
NO
TIMEOUT ?
YES
2.2
2.3
YES
ESTIMATE LOOKAHEAD-LOSS
2.4
2.5
NO
PACKET LOSS DETECTED ?
YES
ENTER k-SACK FAST RECOVERY
2.6
YES
IS LOOKAHEAD-LOSS<k?
NO
2.7
2.8
2.13
ENTER HALT GROWTH
k-RECOVERY PHASE
NO
2.10
2.9
YES
TIMEOUT ?
NO
RECV. ACK ?
2.14
NO
RECV. ACK ?
NO
TIMEOUT ?
YES
YES
YES
ESTIMATE LOOKAHEAD-LOSS
ESTIMATE LOOKAHEAD-LOSS
2.11
2.9
2.12
2.11
IS FAST RECOVERY COMPLIETE?
NO
IS FAST RECOVERY COMPLIETE?
NO
YES
YES

FIG.2



(0) – SLOW START/CONGESTION AVOIDANCE PHASE

(H) – HALT GROWN PHASE

(K) – KRECOVERY PHASE

* IF KRECOVER=0 SSTHRESH=CWND/2
ELSE SSTHRESH=SSTHRESH

FIG.3

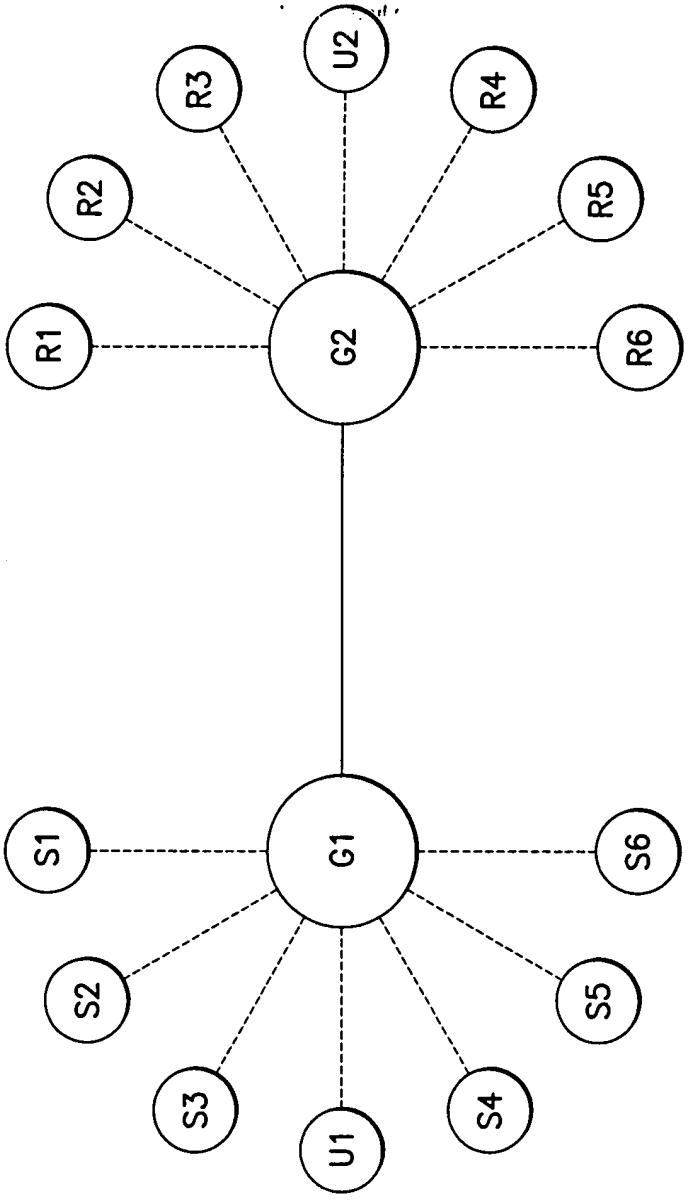

U2
R3
R4
R2
R5
R1
G2
R6
10 Mbps, 5 msec
100 Mbps, 8 msec
S1
G1
S6
S2
S5
S3
S4
U1

FIG.4

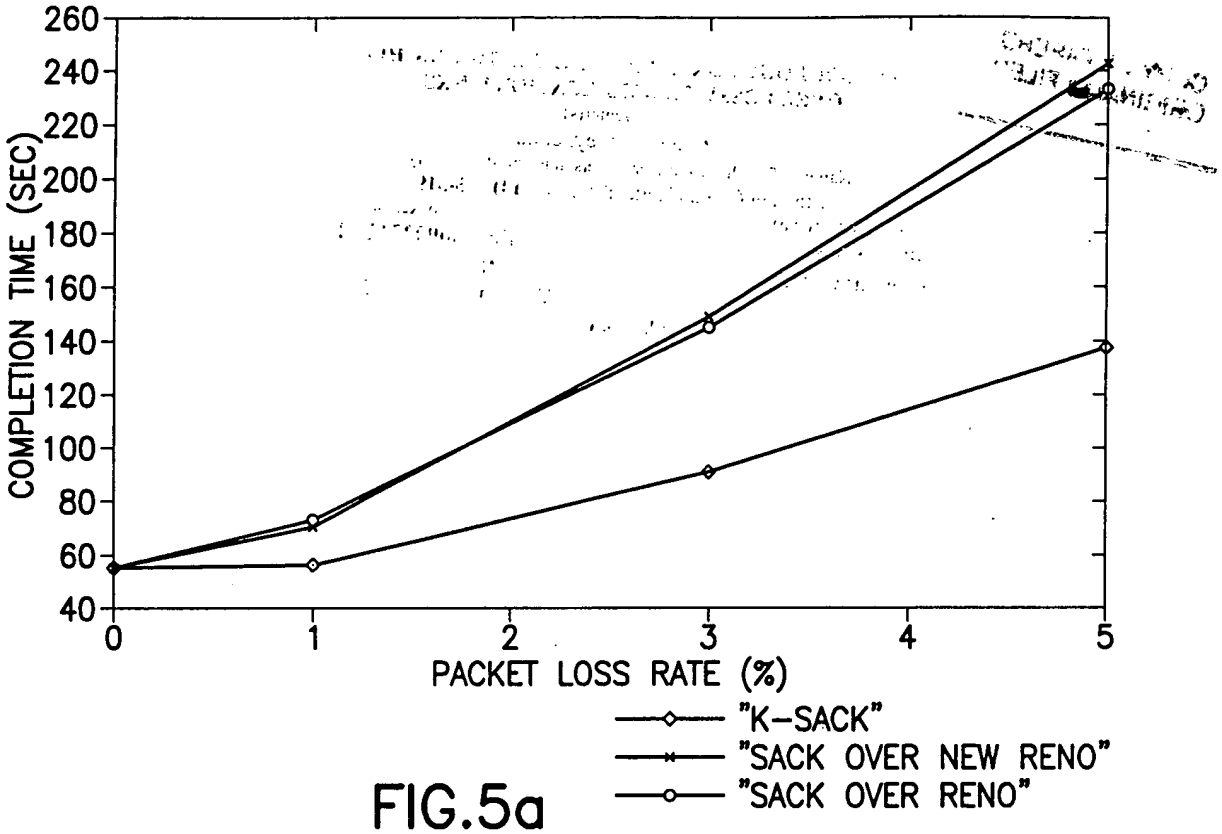

COMPLETION TIME (SEC)
260
240
220
200
180
160
140
120
100
80
60
40
0
1
2
3
4
5
PACKET LOSS RATE (%)
"K-SACK"
"SACK OVER NEW RENO"
"SACK OVER RENO"

FIG.5a

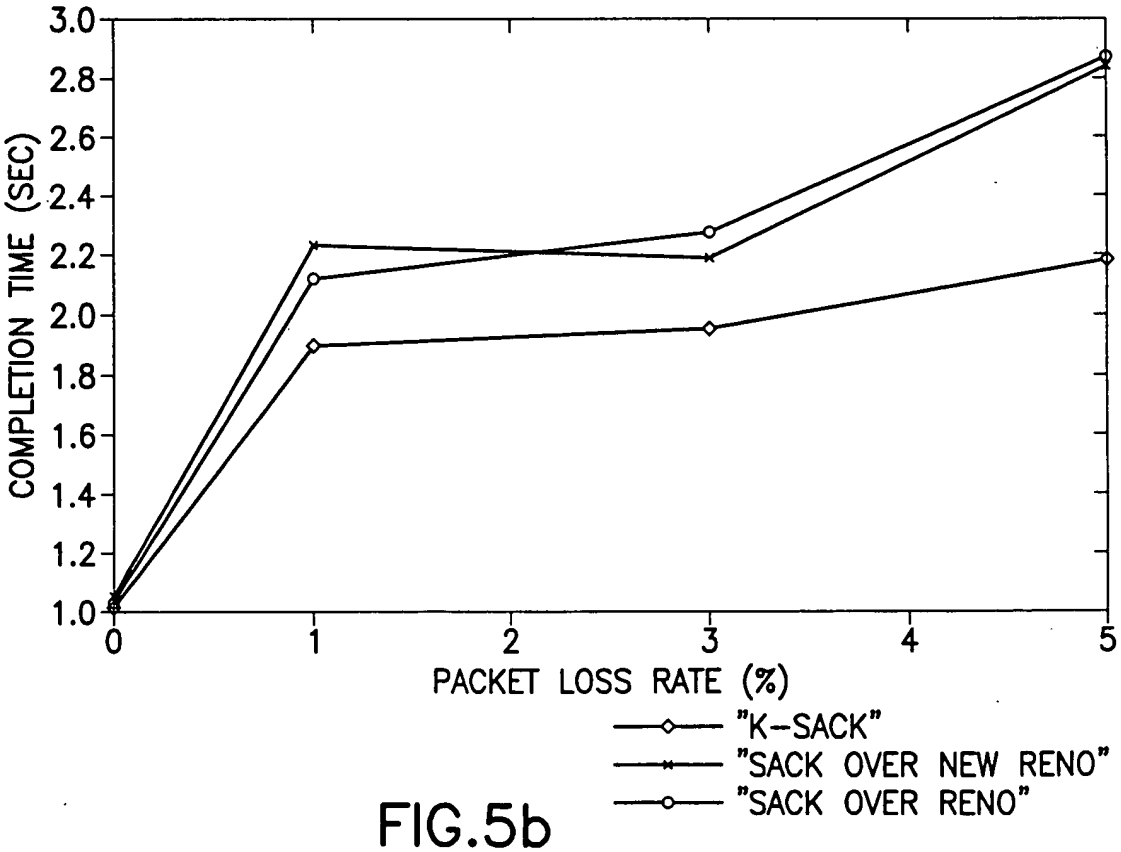

COMPLETION TIME (SEC)
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0
1
2
3
4
5
PACKET LOSS RATE (%)
"K-SACK"
"SACK OVER NEW RENO"
"SACK OVER RENO"

FIG.5b

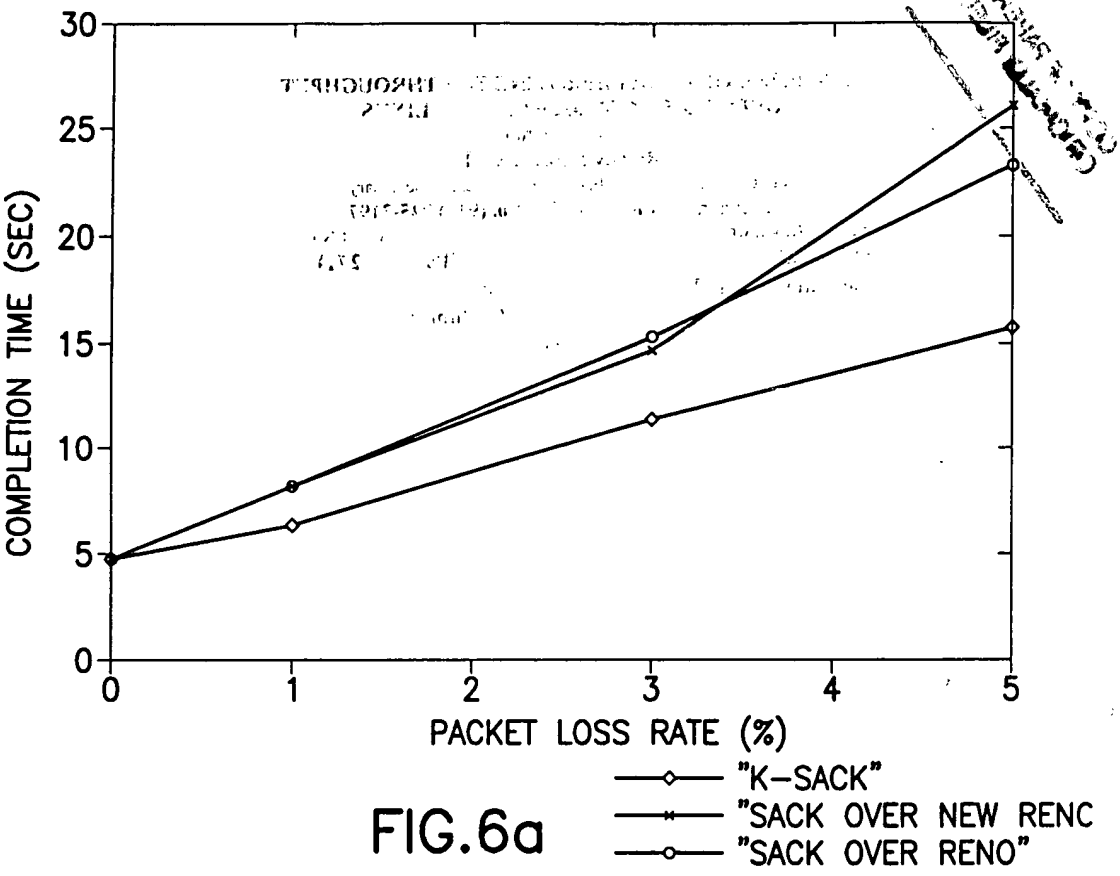

30
25
20
15
10
5
0
COMPLETION TIME (SEC)
0
1
2
3
4
5
PACKET LOSS RATE (%)
"K-SACK"
"SACK OVER NEW RENC
"SACK OVER RENO"

FIG.6a

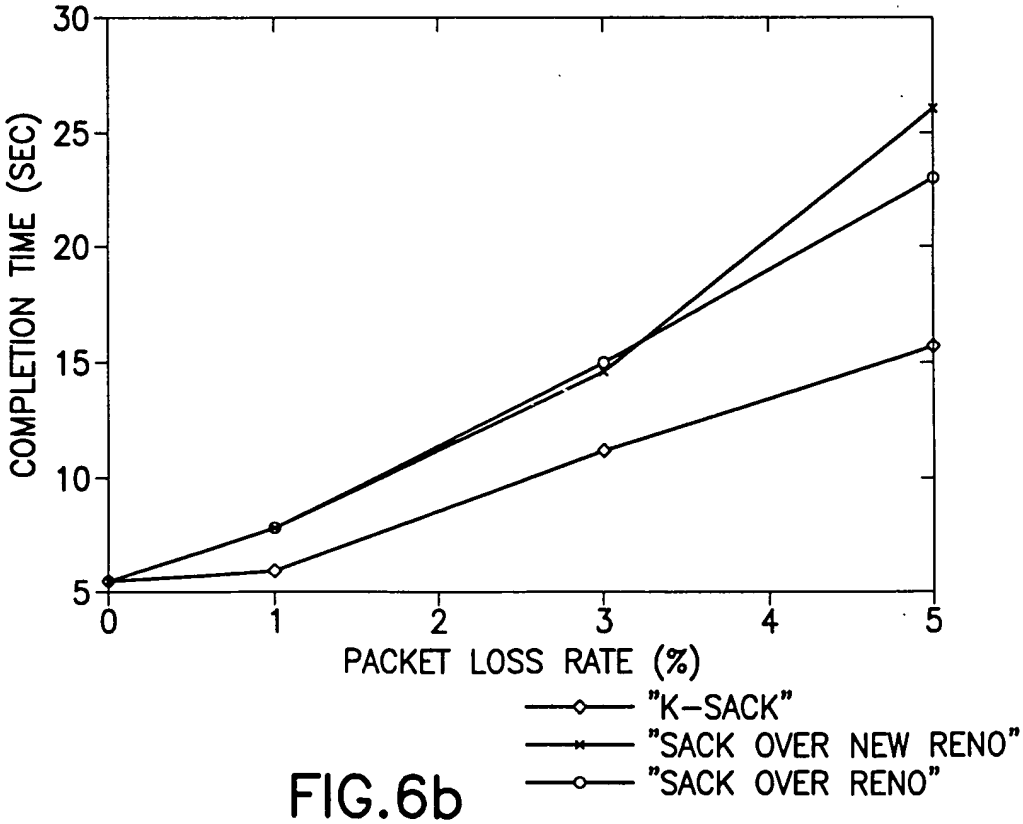

30
25
20
15
10
5
COMPLETION TIME (SEC)
0
1
2
3
4
5
PACKET LOSS RATE (%)
"K-SACK"
"SACK OVER NEW RENO"
"SACK OVER RENO"

FIG.6b

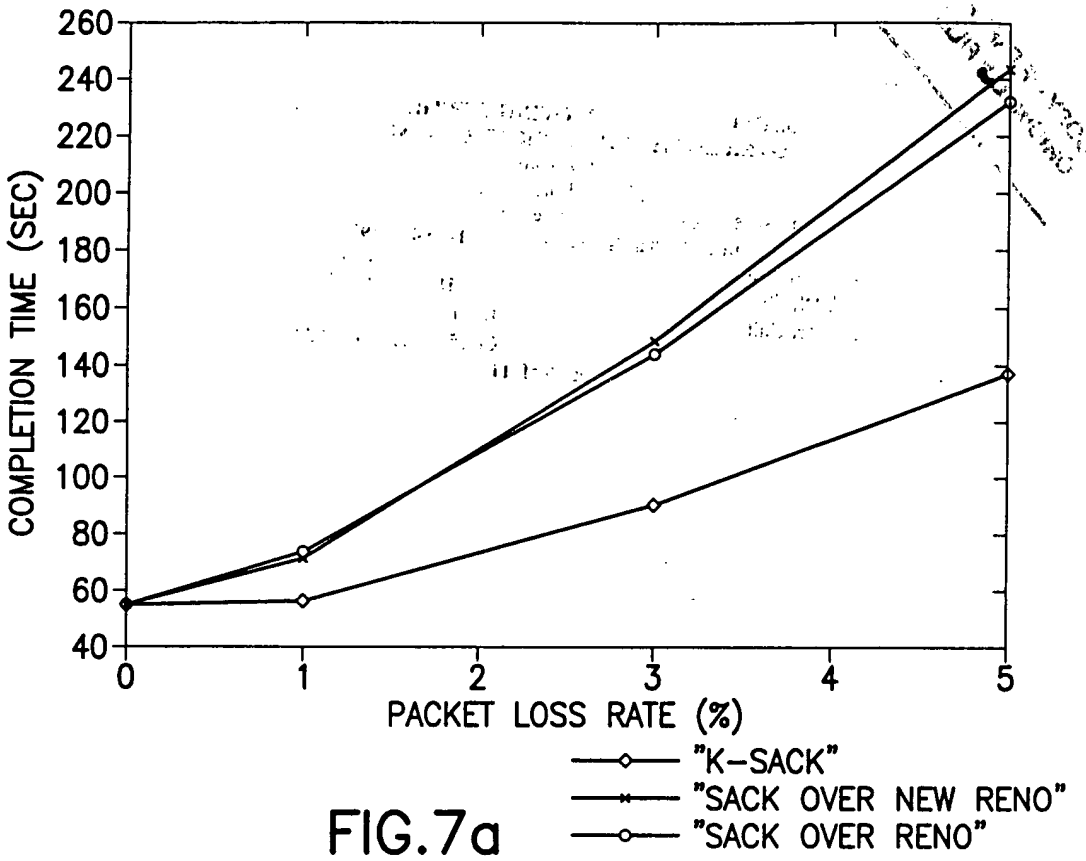

260
240
220
200
180
160
140
120
100
80
60
40
COMPLETION TIME (SEC)
0
1
2
3
4
5
PACKET LOSS RATE (%)
"K-SACK"
"SACK OVER NEW RENO"
"SACK OVER RENO"

FIG.7a

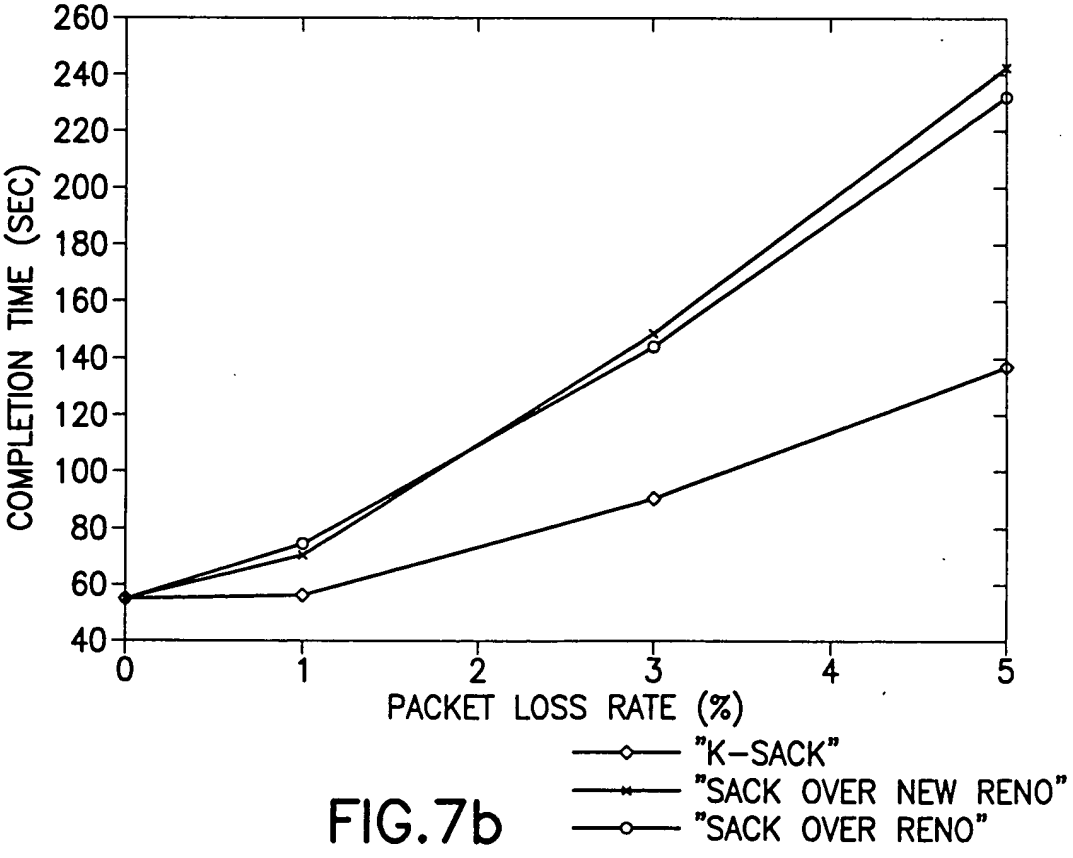

260
240
220
200
180
160
140
120
100
80
60
40
COMPLETION TIME (SEC)
0
1
2
3
4
5
PACKET LOSS RATE (%)
"K-SACK"
"SACK OVER NEW RENO"
"SACK OVER RENO"

FIG.7b

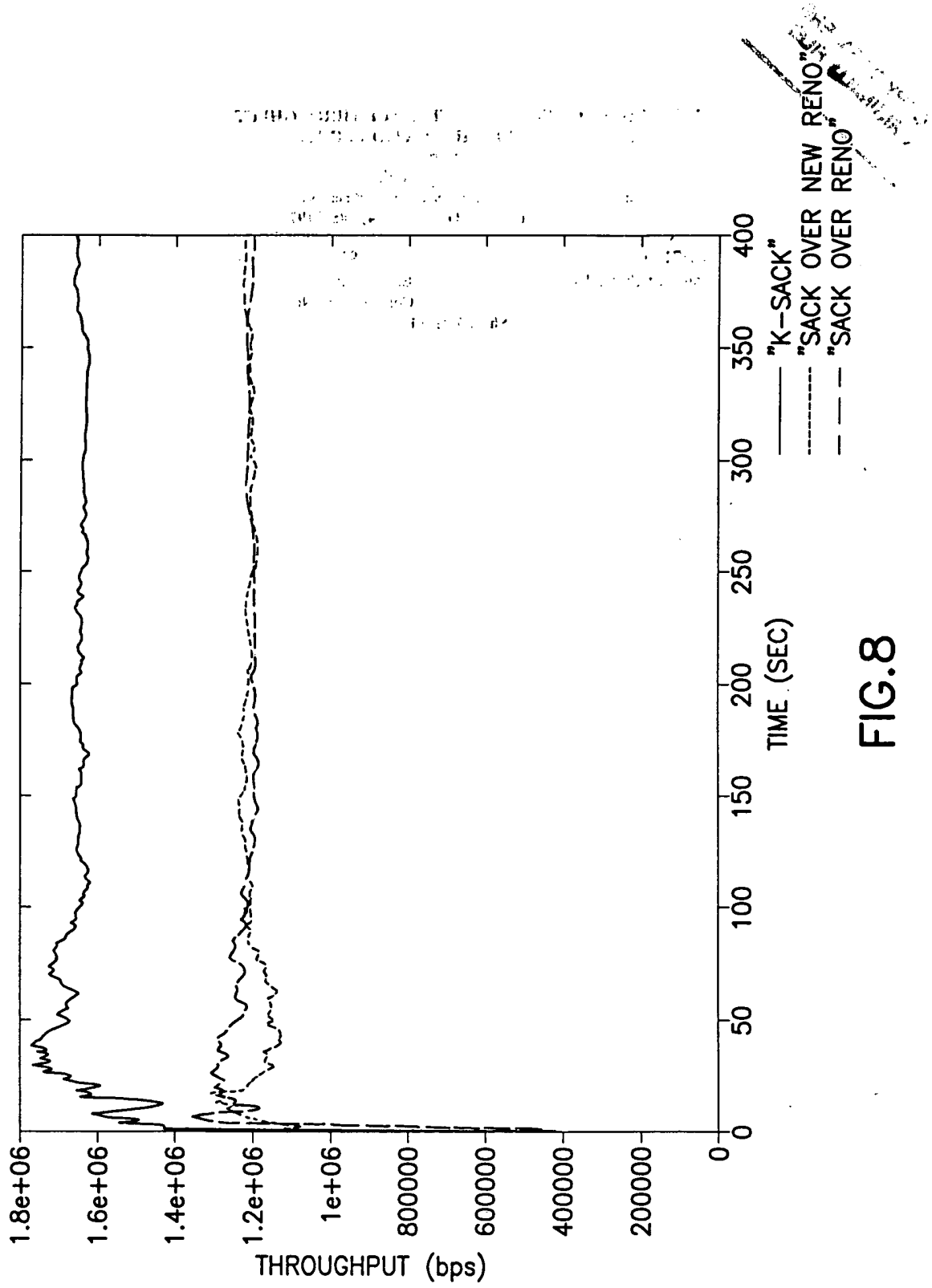

THROUGHPUT (bps)
1.8e+06
1.6e+06
1.4e+06
1.2e+06
1e+06
800000
600000
400000
200000
0
TIME (SEC)
0
50
100
150
200
250
300
350
400
"K-SACK"
"SACK OVER NEW RENO"
"SACK OVER RENO"

FIG.8

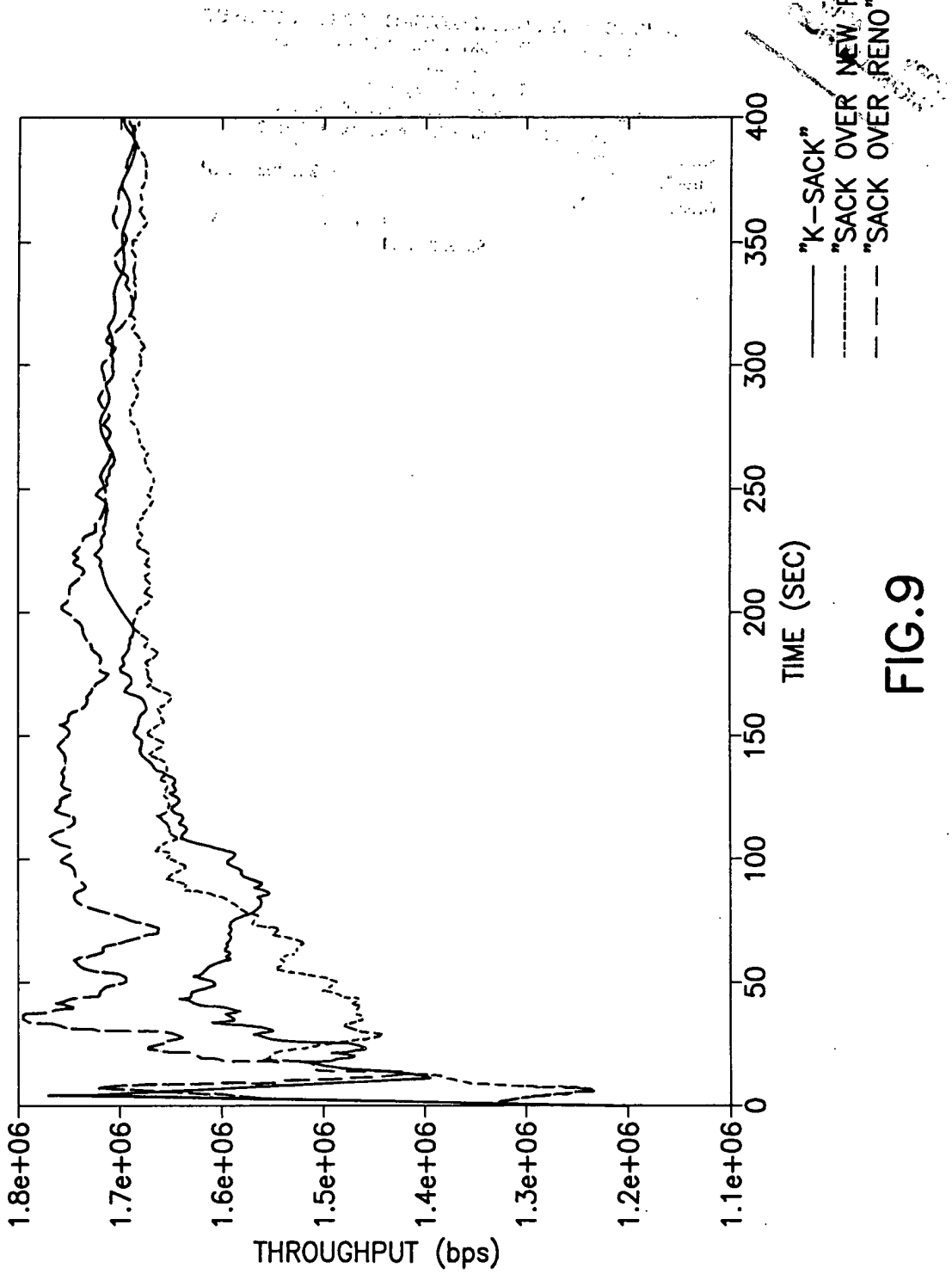

"K-SACK"
"SACK OVER NEW RENO"
"SACK OVER RENO"
THROUGHPUT (bps)
1.8e+06
1.7e+06
1.6e+06
1.5e+06
1.4e+06
1.3e+06
1.2e+06
1.1e+06
TIME (SEC)
0
50
100
150
200
250
300
350
400

FIG.9

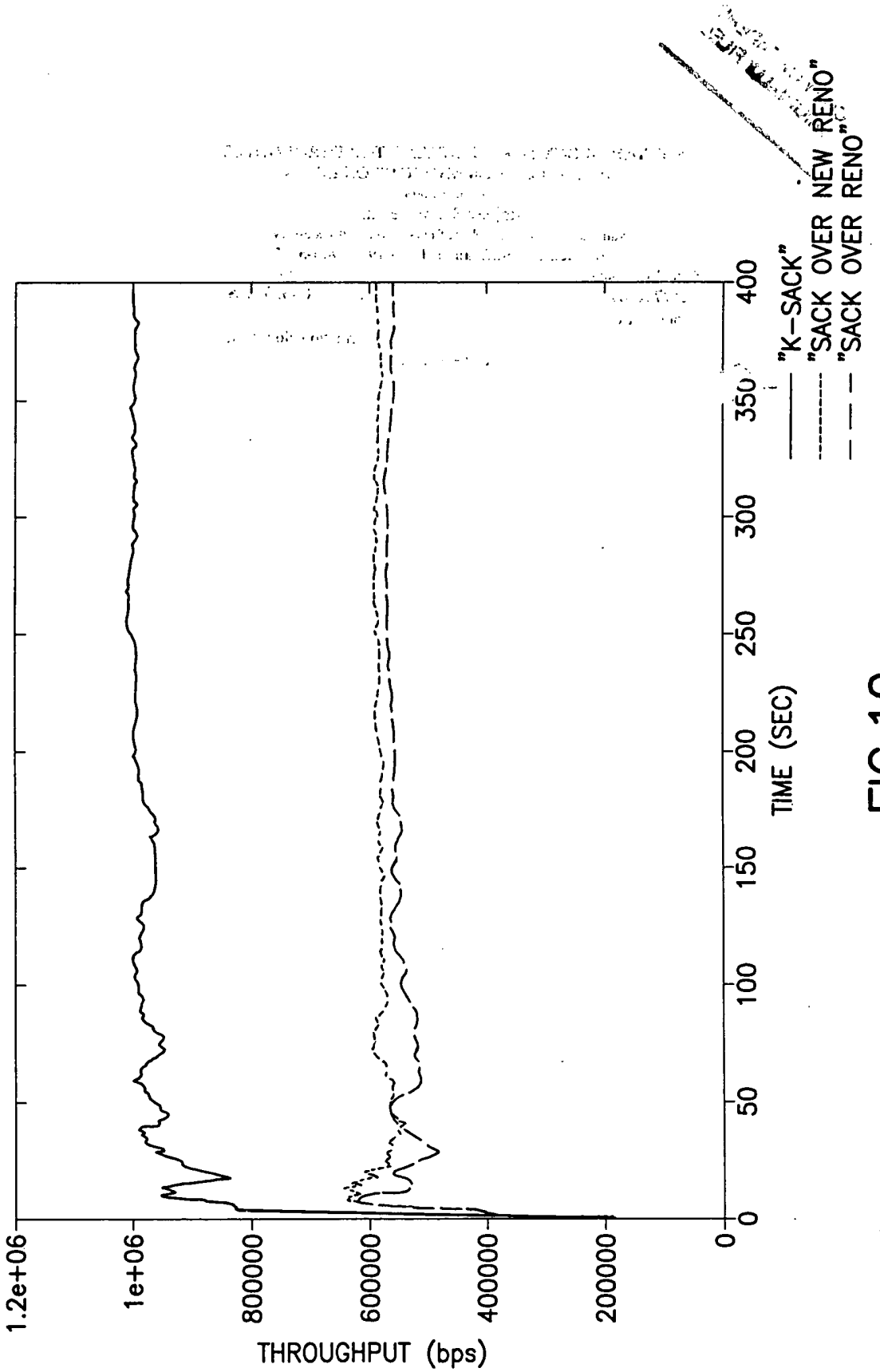

"K-SACK"
"SACK OVER NEW RENO"
"SACK OVER RENO"
THROUGHPUT (bps)
1.2e+06
1e+06
800000
600000
400000
200000
0
TIME (SEC)
0
50
100
150
200
250
300
350
400

FIG.10

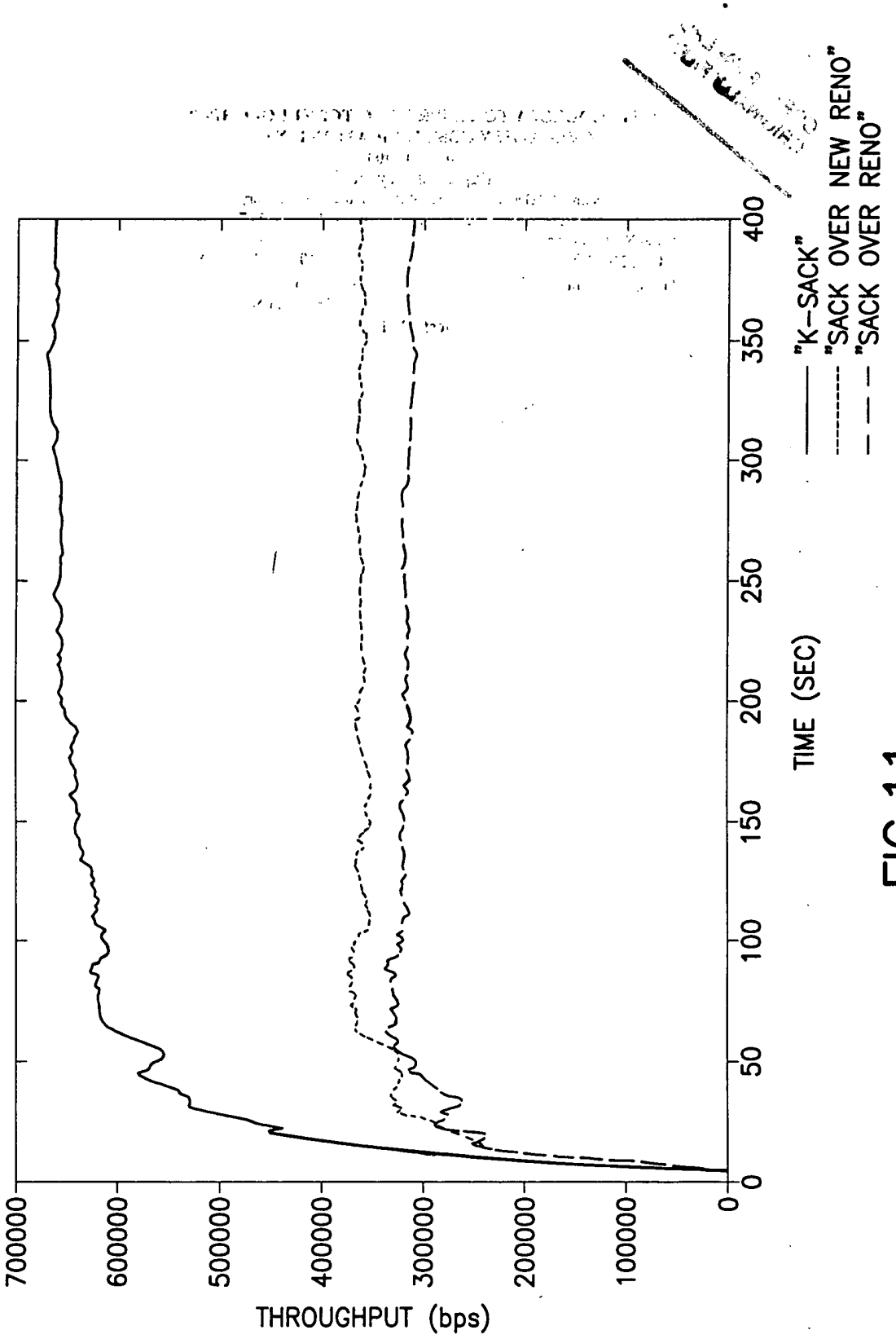

THROUGHPUT (bps)
700000
600000
500000
400000
300000
200000
100000
0
TIME (SEC)
0
50
100
150
200
250
300
350
400
"K-SACK"
"SACK OVER NEW RENO"
"SACK OVER RENO"

FIG.11